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More From Our Forested Resources

1977 Research Accomplishments

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Forest Service U.S. Department of Agriculture

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MORE FROM OUR FORESTED RESOURCES

1977 RESEARCH ACCOMPLISHMENTS

FOREWORD

A major responsibility of the Forest Service is to provide scientific information to make the best use of the Nation's 1.5 billion acres of forest and related rangelands. Assisting in this endeavor are the Forest Service's eight regional Experiment Stations, and a Forest Products Laboratory. The Forest Service also conducts research cooperatively with universities and other organizations.

This report highlights some major findings coming from the research efforts of the Forest Service in 1977. It illustrates how these findings will be or are being used to obtain more benefits from forest resources. The report also includes an index of published research material for the year.

The information presented in this publication is necessarily brief. Additional information about items that interest you can be obtained from the research headquarters responsible for each reported subject. Please write these research stations directly. Their addresses are listed on the inside back cover.

JOHN R. McGUIRE
Chief

Urban Forests Save Energy

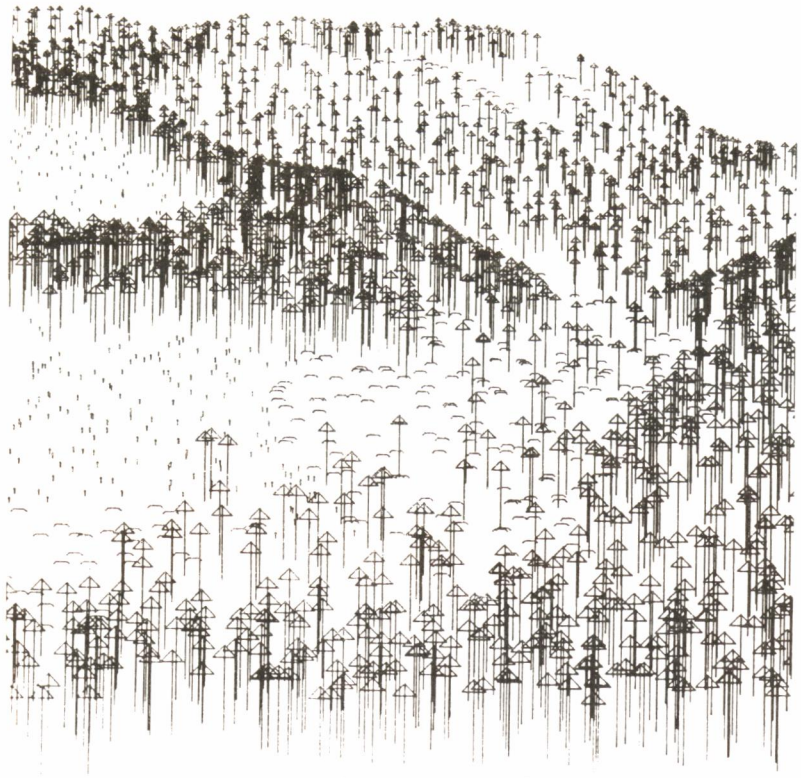
Cities tend to be hotter when it's hot, colder when it's cold, and windier when it's windy than are surrounding natural areas. Researchers at the Northeastern Station have found that banks of trees—urban forests—can do a great deal to relieve these conditions. Trees can also reduce noise levels.

Preliminary research indicates that reductions in windspeed by trees around dwellings can result in fuel savings of between 10 and 25 percent. Measurements of noise and fuel use with and without trees are being continued, and recommendations are being prepared for application on Federal, State, and private lands in the Northeast.

One thing seems certain—if there are trees on a building lot before a house is constructed, it pays to keep those trees. Trees contribute as much as 12 percent to the value of suburban residential properties and as much as 25 percent to the value of unimproved building sites. Preliminary findings are that these increases in value far exceed the costs of saving trees during house construction.

A house without trees is harder to heat and cool than a house surrounded by trees.

Trees also cut down on noise and increase property values.



Drawings produced by PREVIEW should help foresters to estimate the visual impacts of forest treatments.

Visual Management

Foresters are very sensitive to the charge that they create ugliness in timber harvesting operations. They recognize the need to preserve and enhance the beauty of forest vistas. To do so, however, they need to be able to visualize the effects of major operations on the beauty of the landscape. The Northeastern Station has produced a computer program that should help.

This program, called PREVIEW, converts mapped treatments into perspective drawings that show how changes will appear from selected viewing points. PREVIEW can produce a series of drawings showing not only how an area will look immediately after a timber harvest, but also 10, 20, and 30 years hence.

Revegetation After Mining

The American economy depends heavily upon surface mining for minerals, and that dependence will increase as use of coal increases. Ways must be found to return lands disturbed by surface mining to productive uses. That is one goal of Forest Service research in a program called SEAM (*S*urface *E*nvironment *A*nd *M*ining). Scientists from the Northeastern, Rocky Mountain, and Intermountain Stations are contributing heavily to this program, and their research results are quite encouraging.

No single plant species or revegetation procedure will solve all the problems, because disturbed lands differ so widely. Mining occurs on areas ranging from salt-shrub desert to alpine tundra, and spoils range from toxic acid to saline. Research to date shows, however, that these conditions can be overcome. In the West, experimental plots and demonstration areas have been set up on many types of spoil and revegetation has been successful. Two of the keys to success are careful planning of mining and reclamation and a thorough knowledge of spoil characteristics.

The effects of strip mining can be minimized by getting plants established quickly on disturbed areas.

Investments in breeding of southern pines and in producing superior seeds in orchards will yield handsome profits.

Big Profits From Breeding Superior Trees

Investment decisions are based largely on the prospects for financial gains in both public and private forestry organizations. In public agencies, the goal is to invest public funds wisely; in private organizations, the goal is to produce profits for the owner. Forest Service economics research is designed to identify practices that will yield good returns on investments. A recently completed study in the Southern United States indicates that breeding of superior southern pines is near the head of the list of investment opportunities.

This is no pine-in-the-sky promise. Growth data for the analysis were provided by geneticists and timber management experts, and a great deal of tree improvement work is already underway. In fact, almost 200 million superior trees were planted in the South by industrial and other private landowners in the 1975–76 planting season. The analysis indicates that these landowners will reap handsome profits from their decision, and that other landowners would do well to emulate them.

Volume gains in excess of 12 percent from planting superior trees appear certain. Gains of more than 30 percent are being recorded on about one-fifth of the acres planted with superior pines. The result is an average increase of 30 percent in the present net worth of the plantations. The economists conclude that both public and private owners of large tracts will find it profitable to invest in the seed orchards, nurseries, and genetics research needed to produce superior trees.

Survey Techniques Improved

Plans and policies can be no better than the information on which they are based, and State and national forestry plans are based primarily on the information gathered in State forest surveys. These surveys have traditionally dealt primarily with timber resources, but they are now being expanded to cover other resources of the forest—water, wildlife, soils, and recreation opportunities. A research and development program has been established at the Rocky Mountain Station to improve and speed up national resource assessments. Sound techniques already in use at the Resources Evaluation Units in each Experiment Station will be included in whatever new system is devised. The primary objective is to efficiently inventory many resources in a single operation.

A technique that should improve interpretation of timber resource changes has been developed at the Southeastern Station. There resource analysts have been able to estimate volumes and acreages of timber in various age classes. This information helps show when timber can be harvested to best advantage in terms of long-term timber supplies.

A report issued in 1977 on Kentucky's forest industries showed that pulpwood production has been increasing while output of veneer logs and cooperage logs has been declining. This report is available from the Northeastern Station.

Recent changes in pulpwood production in the South have been reported by the Southern Station. The analysis shows the pulpwood production in 1976 was higher than that in 1975, but still below the record levels in 1974.

According to the North Central Station, northern pulpwood production is 22 percent lower than it was in 1974. Production has declined 12 percent or more in all but two Northeastern and North Central States.

Forest Service survey teams are adept at measuring timber volumes. They are learning how to inventory game habitat.

Bark makes an excellent mulch for revegetating areas disturbed by highway construction, and it can be blown into place with appropriate equipment. (Photo by Stanley E. Corder, Oregon State University)

A Market for Bark in Appalachia

Sawmills near large cities have been making a profit by selling tree bark to urban gardeners as a mulch. Because of their remoteness from metropolitan markets, Appalachian wood processors have not shared in this profitable business. Instead, they have had to burn or otherwise dispose of their bark. Researchers at the Northeastern Forest Experiment Station have found a solution—use the bark as mulch in revegetating soils disturbed by highway construction or strip mining.

The researchers quickly found that bark was entirely satisfactory for this purpose, if it could be spread properly. It is denser and harder to spread than cellulose fiber or straw, the materials traditionally used. They found that a mobile bark blower developed in Oregon transported and applied the bark efficiently.

Results of this research were used by an eastern manufacturer who designed a machine that spreads bark mulch, seed, and fertilizer in a single operation. This large potential market should solve a problem of bark disposal and turn a profit for Appalachian mill owners.

Fast Growing Hardwoods for Fiber and Energy

Demands for wood for fiber products and fuel are expected to more than double by the end of this century, and new methods for culturing trees will probably be required to meet these demands. Research results at the North Central Station indicate that yields of certain hardwood species can be increased severalfold by following some new cultural techniques.

Keys to success include selecting stock that has genetically superior growth rate and providing ideal conditions for rapid tree development. In tests in Wisconsin, biomass yields (wood and bark in main stem and branches) have exceeded 8 tons per acre per year. Hybrids of *Populus* (genus that includes poplars, aspens, and cottonwoods) achieved these yields. Spacing of trees in the plantation and age at which trees are harvested are key factors in the system. Best projected yields with one test hybrid were from a 4-foot spacing and tree harvesting after 15 years. During the last year, the North Central Station published a summary of its findings on intensive culture of plantations.

In experimental plantings, hybrids of *Populus* have yielded more than 8 tons per acre per year when ideal conditions were provided.

Douglas-fir occupies millions of acres of cutover land on the West Coast. A computer program helps to get the most from these second-growth stands.

Computer Gives Better Yield Predictions for Douglas-fir

In the Pacific Northwest, Douglas-fir has naturally seeded onto millions of acres after logging, and foresters need information on the best ways to manage these second-growth stands. How often should they be thinned? What volumes can be expected from thinning? Is fertilizer application worthwhile? How will such treatments affect tree size in the final harvest? The Pacific Northwest Station has done a great deal of research on these questions. The answers, of course, depend upon the quality of the site on which a stand is growing. Results of numerous spacing, thinning, and fertilization studies have now been synthesized. Yields from thinning and final harvests of Douglas-fir stands can be predicted with the aid of a computer.

This yield simulator, as it is called, is already being used by the National Forests in the Pacific Northwest as well as by Federal and State agencies and forest industries. The Pacific Northwest Station has prepared a user's guide to the simulator. It tells what sorts of information must be supplied and exactly what kinds of answers will be provided. Results are applicable in the Coast Range and in the Cascades up to elevations of about 2,500 feet. The entire program is available to those who want it, but most will probably prefer to supply information in the proper form and get their answers from a Forest Service computer.

Improving Multiple Use Management

Forests produce timber, water, habitat for a wide variety of wildlife, forage for livestock, and recreation opportunities. Harmonizing management actions to produce an ideal combination of these benefits has always been difficult and complex, particularly on public lands. For one thing, actions that benefit one species of wildlife may create adverse conditions for another species. Before major management decisions are made on National Forests, alternative courses of action and their effects upon benefit production are presented for public comment. A way has long been needed to quickly determine the effects of many timber management alternatives on production of other benefits.

A scientist at the Southeastern Station has devised a system for doing just that. The system, which makes heavy use of a computer, displays the effects of changes in timber-cutting schedules on production of other benefits and adverse effects. Benefits and adverse effects are assumed to be directly related to the proportions of the forest in various age classes and to the sizes of openings made in timber harvests. The exact relationships must be specified by the manager, but he can draw on a great deal of research and experience in doing so. Once the relationships have been mathematically described, the computer will display benefits and adverse impacts for any of a multitude of management alternatives that lead to a stable distribution of stand age classes within a forest.

The system has been fully programed and demonstrated for a mixed hardwood watershed in the southern Appalachians, but it can be applied to any forest situation. A publication describing the system and the computer program, called DYNAST, is available from the Southeastern Station.

New management system has been demonstrated on upland oak stands in the Southeast, but it can be applied throughout the country.

Containerized Seedlings Aid Reforestation

About 3 million acres of southern pine must be reforested each year if predicted demands for stumpage in the year 2,000 are to be met. Currently, less than half of that goal is being met, but research studies and pilot tests by the Southern Station indicate that containerized seedlings will help in the needed reforestation efforts.

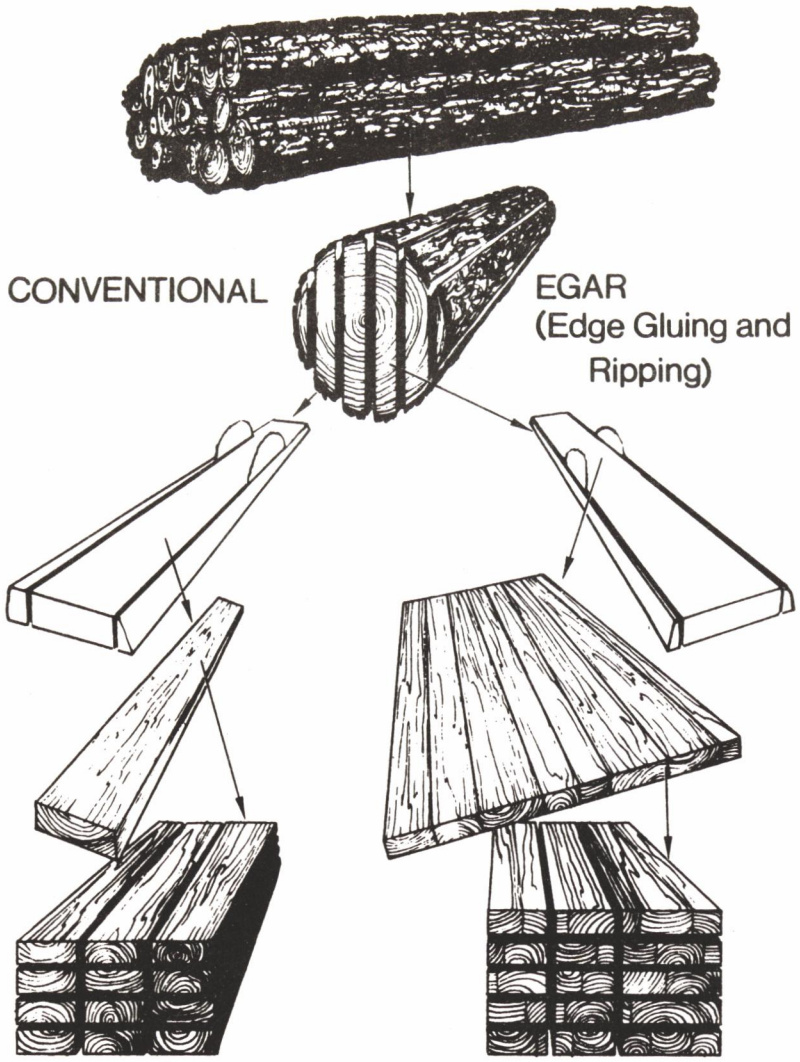
The traditional method of planting is to lift seedlings from nursery beds and plant the bare-rooted stock in the field. Seedlings must be dormant for this method to succeed. A containerized seedling is grown in the nursery in a small, low-cost container that holds both the seedling and its soil. The seedling is outplanted in its container, which breaks down as the seedling develops. One advantage of the containers is that they are highly adaptable to mechanized planting. Another is that they improve nursery survival. But perhaps the most important advantage is that they permit an extension of the planting season, which is all too brief for the big job that is required.

The research findings are now being applied on several National Forests, and State and private organizations are considering their use. Containerized seedlings may not be the entire answer to shortfalls in reforestation, but they certainly should help.

Guidelines for Hardwood Nurserymen

After years of planting only conifers, foresters in the Eastern United States have become interested in planting hardwoods on the sites where they outperform conifers. Very few forest nurserymen, however, are proficient in raising hardwood seedlings. The nursery practices developed for conifers often do not work with hardwoods. Furthermore, there are so many hardwood species, each with special nursery requirements. Scientists at the North Central Station found that much of the information that nurserymen needed had been published, but in widely scattered research reports.

To solve this problem, they gathered all the available information and published an illustrated guide for hardwood nurserymen. The guide covers a wide range of topics, including management of soil; collection, extraction, testing, and sowing of seeds; and protection, care, inventory, packing, and shipping of seedlings. The book should help nurserymen in the eastern half of the United States to meet rapidly increasing demands for high-quality hardwood seedlings.



More and Better Lumber from Small Logs

Approximately 20 billion board feet of softwood dimension lumber are produced each year in the United States by methods that waste wood. Much of this waste results from removing the edges of pieces to produce lumber of standard width. Also, the width of the lumber produced is restricted by the size of the log from which it came. Researchers at the Forest Products Laboratory have found a way to get around this limitation and eliminate much waste.

In their system, small logs are sawn into boards of maximum width. The edges of these boards are trimmed and the boards are fused together edgewise, with waterproof glue. The flat panels produced by gluing are then ripped into lumber of the desired width.

With this system, lumber of any width can be produced from small trees. Furthermore, test runs show that the lumber produced is stronger, and that yields from logs are increased by about 10 percent.

A Machine for Mountain Logging

Mountain loggers in the Eastern and Western United States have long needed a machine that would remove logs from young stands on steep slopes without damaging the soil or the uncut trees. In the absence of such a machine, foresters have been unable to prescribe thinnings that they knew were needed. Working closely with private industry, engineers at the Pacific Northwest Station have come up with a solution. They call it the peewee yarder.

This machine was designed to handle small logs efficiently and quickly. It uses a skyline system that lifts logs off the ground, eliminating soil damage. Major innovations in the design of the drum drive permit line speeds of up to 750 feet per minute. High speed is necessary if movement of small logs is to be economical.

A prototype has been assembled and is being tested in the field. Use of the peewee should greatly improve timber culture on steep slopes.

A virus greatly magnified by an electron microscope.

Douglas-fir Tussock Moth

In recent years one of the most damaging forest insects in America has been the Douglas-fir tussock moth. The Forest Service has joined with three other agencies in the U.S. Department of Agriculture, many universities, several States, and forest industries in a coordinated research program. The objective is to find environmentally sound ways to minimize damage by this insect. Major progress has been made.

Methods have been developed for predicting the severity of tussock moth outbreaks. Such information is extremely valuable to forest managers, who wish to know whether control efforts are needed or whether they are economically justified. Estimates can be made of the amount of defoliation, tree mortality, growth reduction, and topkill that can be expected without control and with standard treatments.

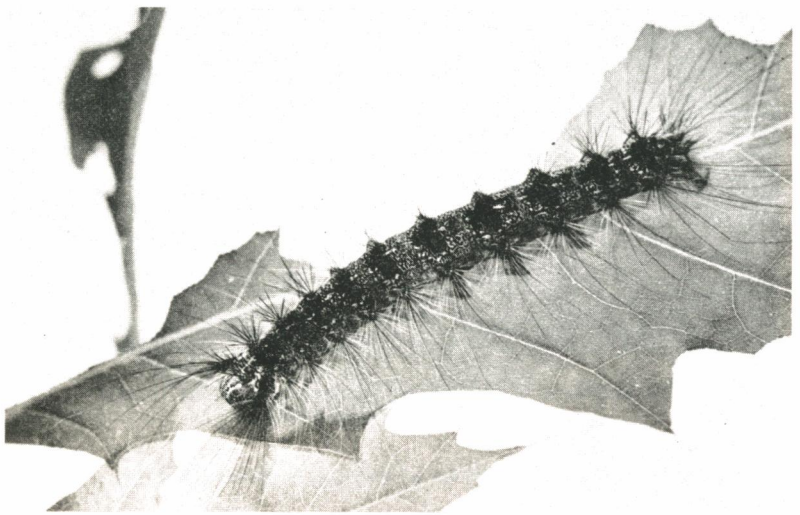
The sex attractant released by female moths to attract males has been synthesized in a laboratory. It has proved extremely attractive to males. When this material, which entomologists call a pheromone, is formulated for slow release and deployed in sticky traps, the presence of tussock moths can be detected where populations are too low for detection by previous methods.

Several chemical controls have been tested for effectiveness and environmental safety. One insecticide, is now registered for aerial application on tussock moth infestations, and another has been submitted for registration by the Environmental Protection Agency. Both of these chemicals present little hazard to small mammals, insect-eating birds, fish, and aquatic organisms.

Probably the safest control substance found so far, however, is not a chemical insecticide at all. It is a naturally occurring polyhedrosis virus (NPV), and it was registered for use against the Douglas-fir tussock moth in 1976. This is the first time that a virus has been registered for use against a forest insect, and is the culmination of 13 years of research and development at the Pacific Northwest Station. This work included isolation, identification, and description of the virus, development of insect-rearing and virus production methods, safety testing, formulation of a virus spray, and development of application methods. The virus is highly specific—it damages only the target insect. Tests with mammals, fish, birds, and other insects have shown no adverse effects.

Virus kills a high percentage of tussock moth larvae.

Hardwoods in winter? No, hardwoods in July! Gypsy moths have completely defoliated them. This insect (below) is a major pest in cities as well as rural areas.



Gypsy Moth

One of the most promising developments in gypsy moth control is also a virus. It reduces moth populations and protects foliage quite well. Registration of this virus by the EPA for use against the gypsy moth has been applied for, and research on its value, safety, and use is continuing.

An insecticide is also under close study. Very small amounts of this chemical (0.03 to 0.06 pounds per acre) have been shown to inhibit molting of gypsy moth larvae. Tests are now underway to determine whether even smaller amounts may be effective. Multiple applications of the chemical may eradicate infestations in remote areas. This insecticide is unique in its mode of action, selectivity, and high toxicity to certain insect species at low dosages. These characteristics appear to make it unsually safe to use.

Effective controls of this insect will be welcomed by people throughout the Northeast. It is a major pest in cities and suburbs as well as in rural areas.

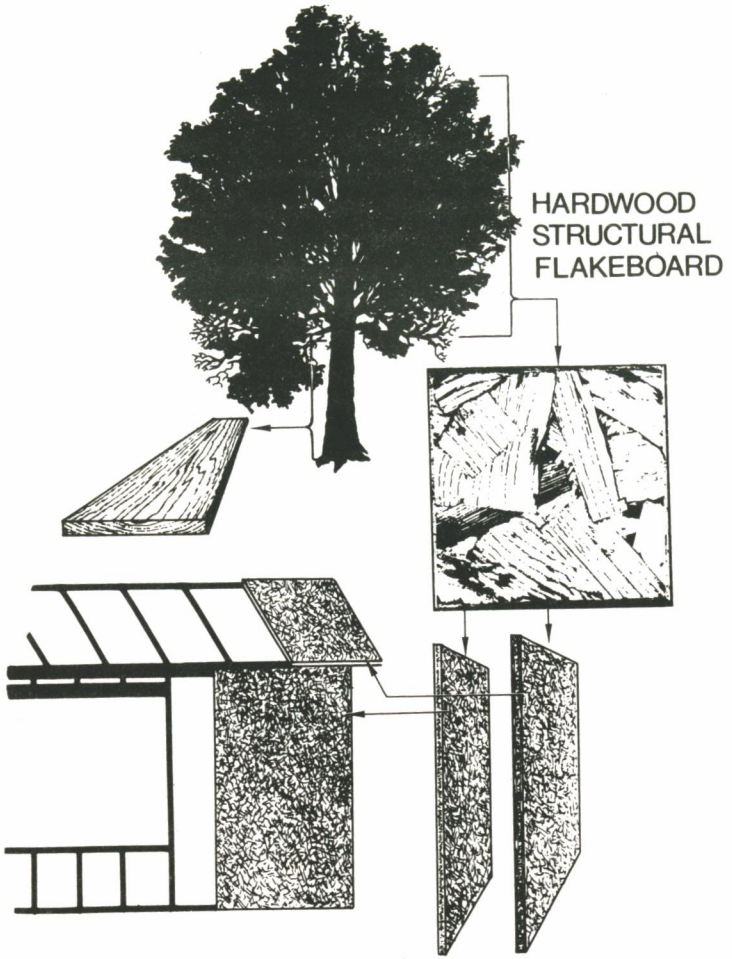
Raising Timber and Elk

Elk are a favorite big-game species in the Rocky Mountains, and foresters want to favor them in their timber management prescriptions. They also want to disturb the animals as little as possible during timber harvesting. A scientist at the Rocky Mountain Station is supplying the information needed to harmoniously produce timber and elk.

Animal behavior has been closely followed in the research by tracking, direct observation, radio telemetry, and time-lapse photography. In radio telemetry an animal is captured and a small transmitter is attached to it. Then the movements of the animal can be observed at long range without disturbing it.

The research has shown what types of habitat the animals require. It has also shown that elk prefer to keep at least half a mile away from working loggers. Traffic on roads has less effect—animals commonly approach to within a quarter of a mile of well-used roads. Foresters are using such information in planning logging operations. State game commissions are using the information to determine quotas of animals that should be harvested to keep populations within the carrying capacity of the land.

By attaching radio transmitters to captured animals and releasing them, scientists have been able to observe the effects of disturbances, such as logging, on animal behavior.



Finding Uses for Small Hardwood Trees

Huge volumes of potentially usable hardwoods in the Eastern and Southern United States are considered unmerchantable. One major goal of Forest Service research is to find profitable uses for these trees. Flakeboard and furniture are two good possibilities.

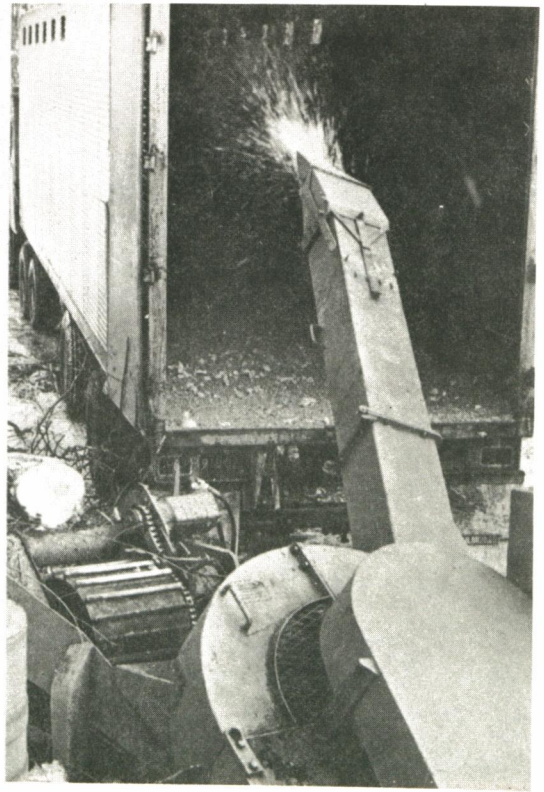
Scientists at the Forest Products Laboratory and at Purdue University think that small and poor-quality hardwood trees might be converted into flakeboard for roof decking. Tests on small samples of the flakeboard have met the engineering requirements for roof decking. In addition, this decking appears to have better insulating qualities than some traditional materials. The flakeboard manufacturing process is highly efficient, and most of the energy required for processing could be produced by burning bark and panel trimmings.

Researchers at the Northeastern and Southeastern Stations believe that satisfactory lumber for furniture can be made from small hardwood trees of medium quality in a method that they developed and called "System 6." Such tree stems are bucked into 6-foot bolts rather than the longer logs that are traditional. Since large, high-quality hardwoods are in very short supply, the furniture industry is showing considerable interest in System 6.

Mechanized Thinning

Millions of acres of young hardwood forest in the eastern half of the United States would benefit from thinning, but there are few markets for the small trees that would be cut. One of the most promising markets is for fuel, probably for industries, but thinning procedures used in the past have not been efficient enough to deliver the wood at a competitive price. Engineers at the North Central Station believe that wood can be competitive if thinning is highly mechanized and highly efficient.

A system that the engineers have been testing appears promising. In rows 10 feet wide, all the trees are mechanically sheared by a large machine that places them in bunches. These bunches are hauled to a landing with a grapple skidder. At the landing, the logs suitable for lumber manufacturing are taken and the remaining material is chipped and blown into vans. These chips might be profitably hauled to nearby industrial plants as fuel. Studies of costs and returns are underway.

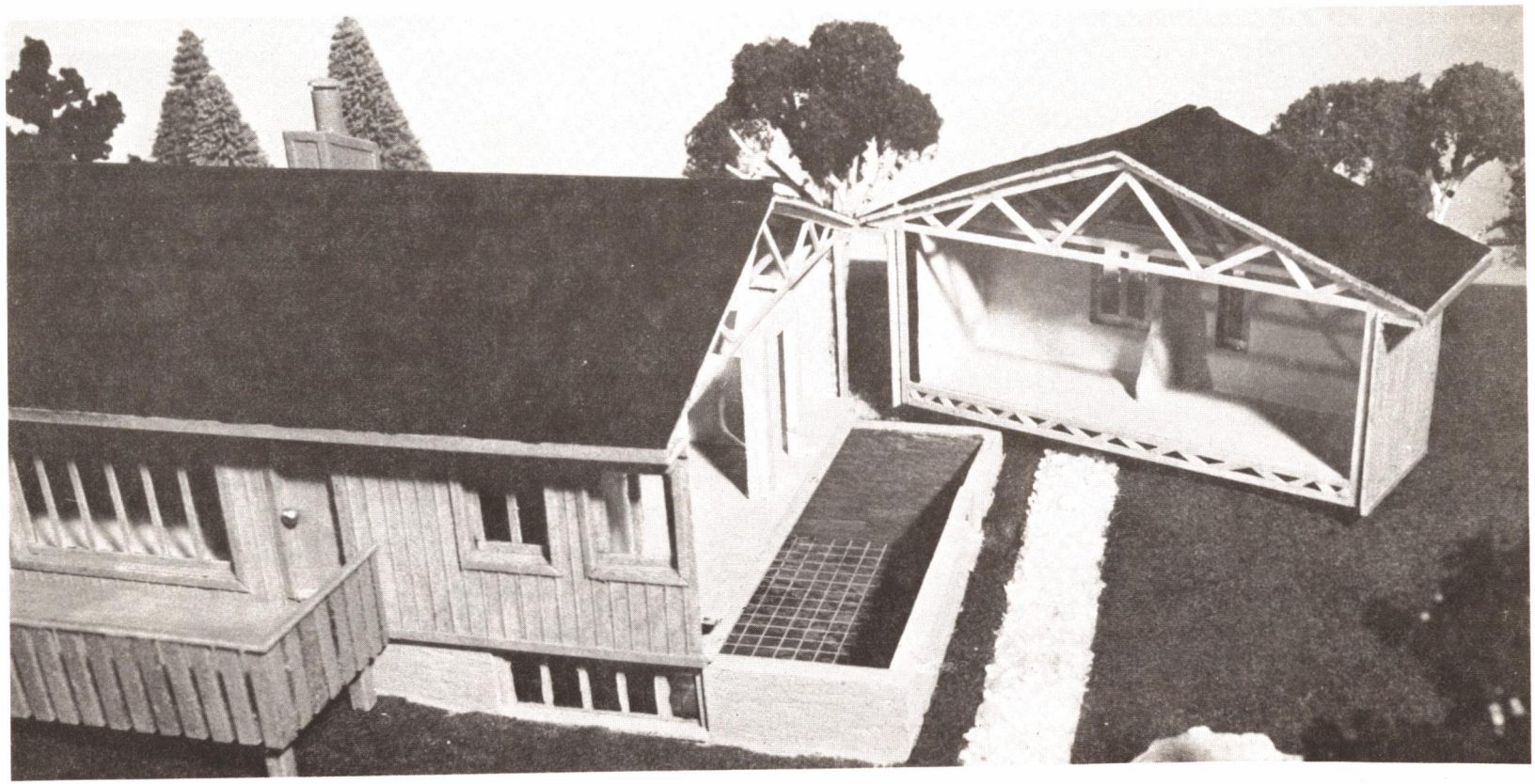


New House Design Cuts Building Costs

The cost of new homes has been rising rapidly, and increases in lumber prices are a contributing factor. An engineer at the Forest Products Laboratory has invented a new frame design that can save both money and lumber. It is called a truss-frame. Both the floors and the roof rafters are trussed (see photo).

Advantages of the system are less framing lumber per square foot of house, use of only one size of framing lumber (2x4's), and elimination of ductwork for heating and cooling. Preliminary estimates are that at least $2,300 will be saved by using this design instead of the conventional one.

The inventor obtained a public patent on the system early in 1977. Since he is a Forest Service employee, this patent permits any firm to use the system without paying royalties. Existing truss plants and wood manufacturing firms have everything necessary to mass produce truss-frames throughout the United States.

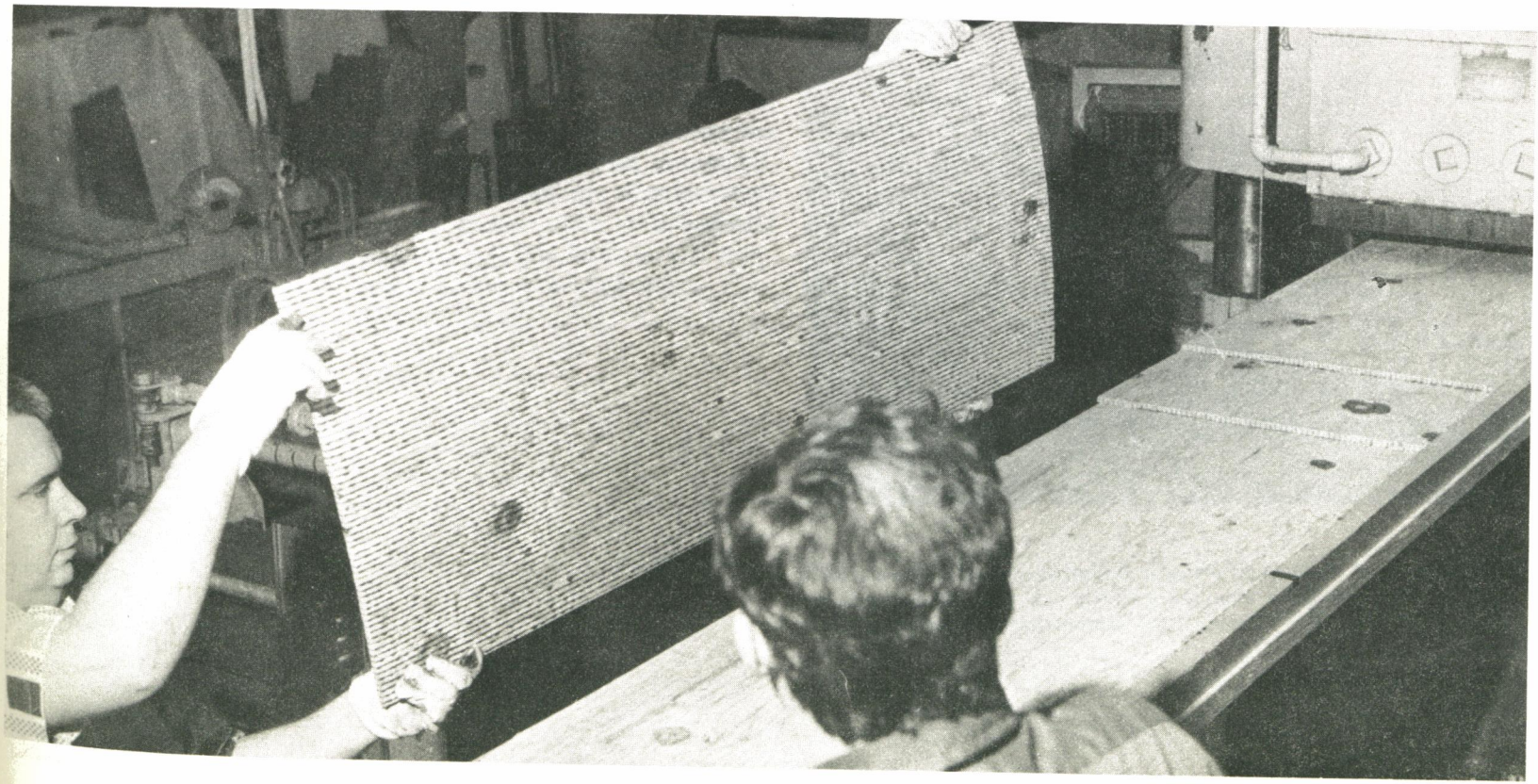


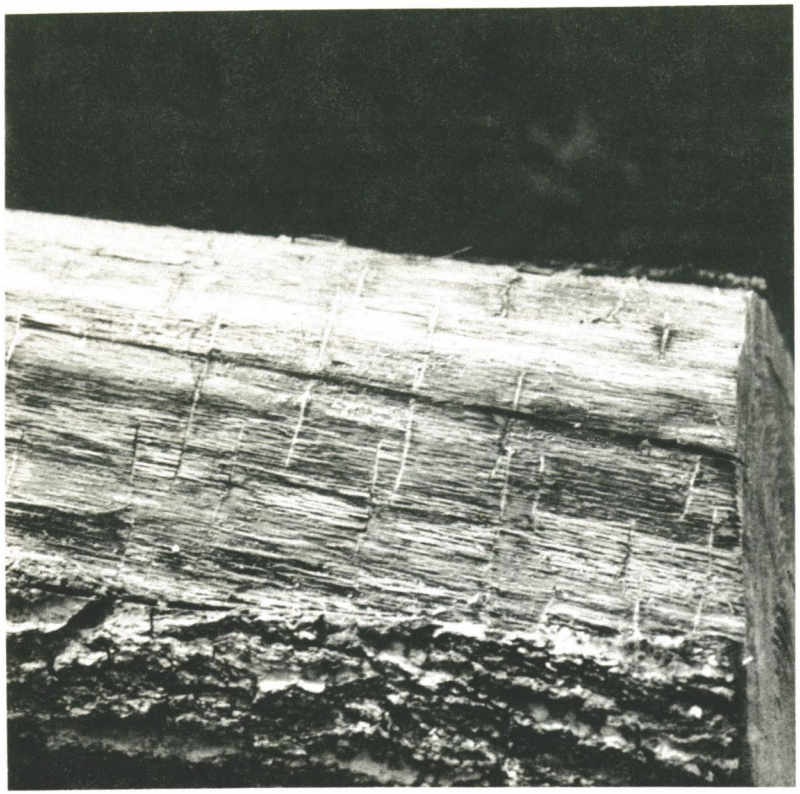
Large Timber From Small Trees

Researchers at the Forest Products Laboratory have perfected a method for rapidly producing large structural timbers from small trees. And the process uses 30 percent less wood than traditional methods. The speed of the system is particularly beneficial because manufacturers will not have to hold materials for long periods while they dry.

The new product is called Press-Lam. Logs are peeled on a lathe into veneer up to one-half of an inch thick. The veneer is cut into smaller sheets and put into a press where heat and pressure combine to dry the wood quickly. The dried sheets are coated with glue while they are still hot and laminated to the desired thickness. This means that manufacturers can make timbers much larger than the trees that provided the wood. And producers can go from log to dried, ready-to-use product in less than 1 hour.

Since the logs are peeled on a lathe rather than sawn, there are no losses in sawdust or slabs and edgings. This is why 30 percent more product can be made from a tree.





Stopping the Spread of Oak Wilt

When a forest tree gets oak wilt, its chances of survival are low, so foresters would like to keep the disease from spreading to neighboring oaks. In hopes of protecting healthy trees, foresters used to girdle diseased oaks, but this treatment proved ineffective. Researchers at the Northeastern Station have discovered a treatment that does help to check the spread of oak wilt.

They found that when the herbicide cacodylic acid was injected into diseased trees under pressure, the likelihood of spread was greatly reduced. The herbicide kills the diseased tree and it kills neighboring oaks with interconnected roots, but these trees would die of the disease anyway.

Data on treatment effects have been submitted to a manufacturer who is applying to EPA for registration of the treatment.

A Good Fungus

We often think of fungi as harmful organisms—causes of diseases—but many are highly beneficial, and scientists at the Southeastern Station are learning how to take best advantage of some beneficial ones.

Certain soil fungi form beneficial associations called mycorrhizae with the roots of higher plants. In fact, many higher plants require these associations for survival and normal growth. The fungi aid in uptake of nutrients from the soil, and may perform other useful functions.

Research is underway to determine the best mycorrhizal fungi for various tree species and soil conditions. Tests show that when nursery beds are inoculated with *Pisolithus tinctorius*, southern pine seedlings on the beds are healthier, grow faster, and require less fertilizer than seedlings on untreated beds. There are also indications that seedlings from inoculated beds will grow considerably faster after outplanting. Methods for commercial production of this fungus are now being tested in cooperation with private manufacturers.

Why are seedings in background outperforming those in foreground? The soil in which they are growing contains a mycorrhizal fungus that sweetgum requires for normal development.

Improvement of Deer Habitat in the South

Nutritional deficiencies in food limit the potential of southern pine forests for deer. Studies at the Southern Station show that these deficiencies can be partially compensated for by providing plots of high-quality forage. On such plots in Arkansas, deer consumed sizable quantities of elbon rye and ladino clover during the winter when acorns were scarce and when native forages were deficient in protein and phosphorus. Small clearings were grazed more heavily than large clearings. Yields and crude protein content of honeysuckle leaves were substantially increased by nitrogen fertilization. In Texas, burning increased the crude protein content of honeysuckle on unfertilized plots. These results indicate that supplementing native winter vegetation for cultivated forages in small plots should increase winter survival of deer in southern forests.

This information is being used by the Arkansas Game and Fish Commission to establish food plots on National Forests and State game management areas. Similar plots are being established on forest industry lands in Texas.

Southern Pine Beetle

The southern pine beetle is extremely destructive during major outbreaks, which are somewhat widely spaced in most of the South. Artificial control measures are difficult to devise because the insect spends most of its life in the inner bark of trees, where it cannot be seen or treated. That is why much of the research on the insect is concentrating on silvicultural methods of population suppression and understanding natural control factors.

The major pathogens (causes of beetle diseases) have been determined in several Southeastern States. Although one pathogen may infect over 90 percent of the beetles, together the pathogens reduce populations by about 22 percent.

Studies of insect parasites and predators show that their densities increase as beetle populations increase. Woodpeckers appear to be particularly effective, consuming up to 80 percent of the beetles in some trees.

Developing an understanding of the site and stand conditions which favor chronic beetle outbreaks will help in devising stand or forest management practices that may reduce susceptibility to the insect. Research has shown that infestations are correlated with stands having high density of large, often overmature trees. Researchers hope to develop an array of information into a stand risk-rating system to help forest managers make decisions concerning stand treatment.

Another possible cause of increased susceptibility to southern pine beetle is a tree pathogen, *Fomitopsis annosa,* which attacks loblolly pine roots and has been found associated with beetle-infested loblolly pines. Scientists think this fungus may be predisposing trees to beetle attacks.

Woodpeckers are efficient predators of southern pine beetles, and insects help too. Clerid larva (left) is about to consume southern pine beetle larva in inner bark.

Habitat requirements for the red-cockaded woodpecker have been determined, and appropriate habitats are being provided on National Forests.

Habitat for Endangered Species

The Forest Service tries to take no action that will harm an endangered species, and when enough is known about the habitat requirements of such a species, ideal conditions are provided for it. Determining habitat requirements is often difficult; the results with the red-cockaded woodpecker at the Southeastern Station show what can be done.

The red-cockaded woodpecker exists in scattered but apparently viable populations throughout the range of southern pines. It is listed as endangered because its nesting habitat—stands of old-growth southern pine—has steadily diminished as timber management has been intensified and rotations have been shortened.

Studies have shown that clans range over areas as large as 555 acres and defend territories as large as 205 acres. Within their territories, the woodpeckers utilize a wide range of stand ages and conditions. They eat many species of insects and spiders.

This information is being used by National Forests in the South to revise habitat management guidelines. The same information has been used by the Endangered Species Recovery Team of the U.S. Department of the Interior, Fish and Wildlife Service, to develop a recovery plan for the species.

Avoiding Avalanche Disasters

The number of winter residents in the Rocky Mountains is increasing rapidly, and in many locations the risk of snow avalanches is very real. The situation is so serious that the State of Colorado has a regulation designating avalanche sites as "areas of State concern." The objective, of course, is to recognize areas of high hazard and to allow only those uses that are compatible with the hazard. This should be done before extensive development takes place and land values soar.

Scientists at the Rocky Mountain Station have produced an avalanche prediction model that should make such an approach possible. The model, which works on a computer, predicts the likelihood of an avalanche in a mountainous area when it is given easily obtainable information about the area. It also estimates runout distance and impact force for probable avalanches. Such information will help avert disastrous loss of life and property in the future.

Forest Service scientists throughout the country are measuring effects of road building and forest treatments on water yield and quality.

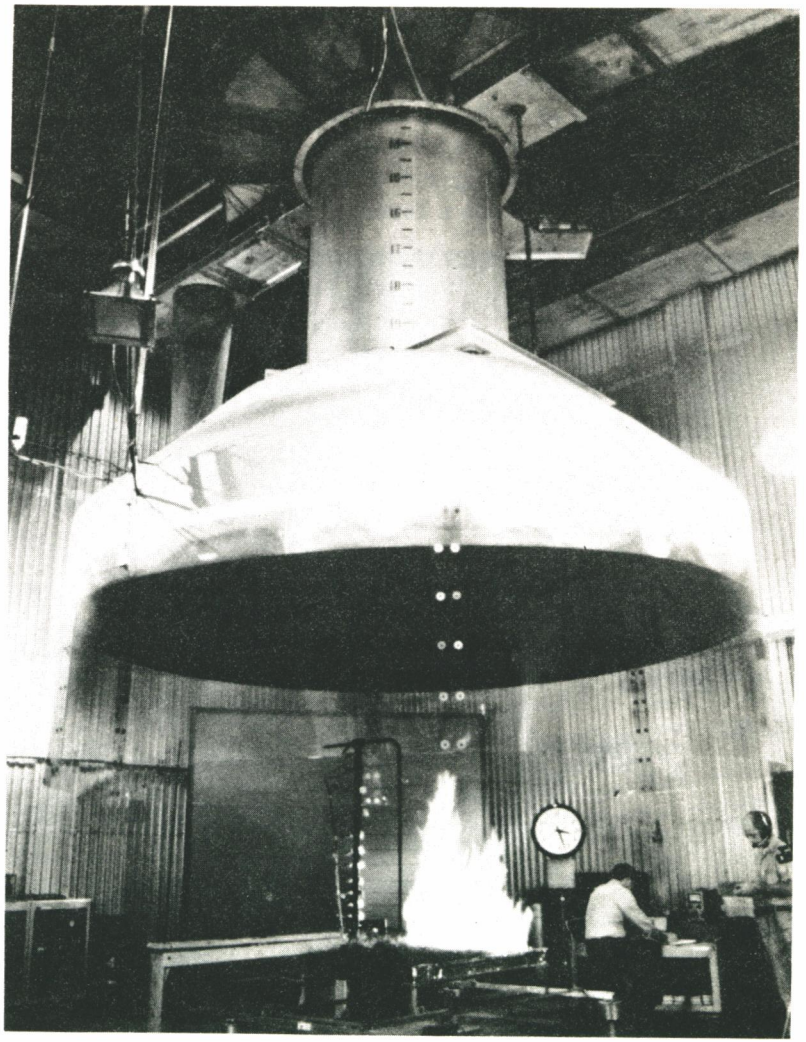
Nonpoint Pollution

Public Law 92-500 holds foresters accountable for water pollution arising from the areas under their management. Since the sources of such pollution are usually large treated areas or roads rather than specific points, they are called nonpoint sources. To assist land managers, Forest Service Experiment Stations all over the country are determining the effects of forest practices on water quality. Research to date pinpoints sediment as by far the most common pollutant. Logging practices and road designs that will aid in reducing sediment production are known, especially for most forest areas in Eastern United States. However, further research is needed.

Erosion in well-managed forests in the central Appalachians ordinarily ranges from 0.05 to 0.10 ton per acre per year. About half this material is sediment and the other half is dissolved minerals. This rate may double during a well-managed logging operation, but it returns to prelogging levels a year or two afterward. Increases in sediment production from careless logging, however, can be far higher and can last much longer.

Smoke Management

Prescribed burning is often the most practical way to prepare a site for reforestation or to eliminate concentrations of fuel that would cause major damage in a wildfire. But burning at the wrong time or place can create unacceptable concentrations of smoke over populated areas or highways. The Southeastern Station has published a forestry smoke management guidebook to help southern land managers and air-quality personnel decide when prescribed burning is acceptable. With the guidebook, a user can predict probable concentrations of particulate matter for up to 100 kilometers downwind from fires. Since these computations can be quite complex, especially if several fires are being planned for in the same general area, a computer program has been developed to help land managers. Weather strongly influences the rate at which a fire burns and the manner in which the smoke disperses. The program for calculating rates of dispersion, therefore, has been combined with automated weather interpretation, and the combined system is being pilot tested in cooperation with the National Weather Service and operational forestry organizations.



In a laboratory, all combustion products from experimental burns are analyzed. In this way, the amounts of kinds of such products can be estimated for field burns.

Estimating Residue Volumes

The unmerchantable wood that is left in the forest after timber harvesting or cultural treatment often creates a fire hazard and can hamper reforestation efforts. Methods have been developed for getting rid of these unwanted residues, but to apply these methods a forester must first estimate how much material is present or will be created by a specific operation. The Pacific Northwest Station has perfected a rapid method for making these estimates.

The Station has published photographs for major softwood types in the region showing various fuel loadings. By comparing local conditions with those shown in the photographs, a manager can quickly estimate the volume present.

A method has been developed for quickly estimating logging residue volumes.

Managing Nongame Animals

In their wildlife management activities, foresters have traditionally favored game animals and given little attention to other wildlife species. The primary cause was a lack of knowledge, but that situation is changing rapidly. Forest Service Experiment Stations all over the country are rapidly accumulating and publishing information on nongame species.

The Pacific Northwest Station has completed some research on the effects of timber management activities on forest bird populations in the Blue Mountains of Oregon and Washington. Cavity nesting birds, particularly woodpeckers, are very sensitive to habitat alterations associated with timber harvesting. Studies show that the size, condition, and location of dead trees (snags) are critical to reproduction of cavity nesting birds. The findings have been incorporated into a simple management system that has been adopted by all Federal and State agencies in the Blue Mountains.

Similar research has been completed by scientists at the Rocky Mountain Station. In Arizona, changes in bird populations have been observed after harvest of mixed conifer forests.

Increasing Streamflow in Arizona

Water supplies for central Arizona are dwindling, but researchers at the Rocky Mountain Station think they have found a solution. They have found that chaparral with its deep roots uses considerably more water than shallow-rooted grasses and forbs. By converting areas of chaparral to grass both the volume and duration of streamflow can be increased. Conversion of about 700,000 acres of Arizona chaparral appears feasible, and such action would increase water yield by 140,000 acre-feet per year.

Some 1,300 acres of conversion are planned on National Forests in Arizona over the next year. Chaparral removal will be accomplished by machine and by prescribed burning. Effects of these treatments on water yield, wildlife, and range quality will be closely monitored.

Converting groundcover from chaparral (left) to grasses (right) can increase flows in Arizona streams.

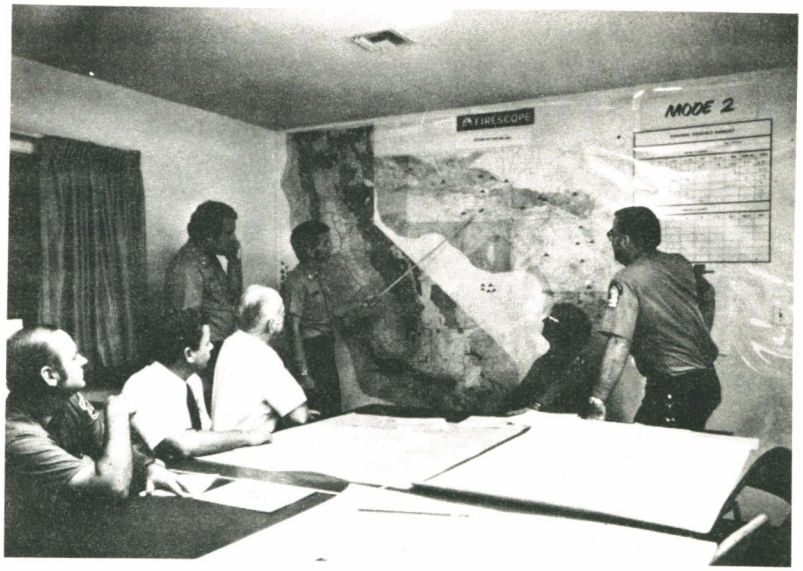
Keeping a Computer Eye on Wild Land Blazes

Take 12 million people, put them into some of the most flammable forest lands in America, and you have southern California. Take a carefully planned command structure, mobilization plan, and communications system, put them together with the most advanced computer assistance, and you have FIRESCOPE, southern California's answer to its forest fire danger.

FIRESCOPE is a research, development, and applications program that was started to determine how men and equipment from many agencies and departments could best be used for large fires and other emergencies. Seven major organizations are participating with the Forest Service in the effort. They include Federal, State, and city agencies. All have worked out a standardized management structure and procedures to use when they are called upon to work together. There is common terminology and common understanding.

The core of the system is the Operations Coordination Center in Riverside, near the Pacific Southwest Station's Forest Fire Laboratory. There, a close eye is kept on potential fire hazards in seven surrounding counties. A vital part of this command center is a computer terminal on which the coordinates of all brush fires and up-to-the-minute weather data are entered. The computer already has stored in its memory details on the age and moisture content of the vegetation and the steepness of the slopes. In seconds, the computer forecasts how fast a fire will spread and in which directions. FIRESCOPE also takes advantage of infrared fire mapping of aircraft flying 10,000 to 15,000 feet above a fire. In this way, fire maps can be kept current at night and in spite of smoke. Much of the research needed to make the system work was completed at the Pacific Southwest Station.

FIRESCOPE is protecting 15 million acres in southern California, but the principles in use there have much broader application. With adaptation, the same concepts and technology could be applied in other areas where major emergencies make multiagency cooperation essential.



Treatment of streamside vegetation strongly affects salmon spawning. Here a Forest Service crew is removing fallen trees from an Alaskan stream.

Timber and Salmon

One of the great wonders of nature is the return of the coho salmon and other anadromous fish from the sea to the streams of their birth for spawning. Forest managers and ranchers need to know if any of their activities are interrupting this phenomenon, and researchers at the Pacific Northwest Station are providing the answers.

Streamside vegetation is very important to fish habitat for two reasons. It reduces stream temperatures and it reduces the amount of sediment reaching streams. The salmon spawns in streambed gravel, often laying its eggs as much as 12 inches below the surface of the gravel. If the gravel is clogged with sediment, sufficient oxygen may not reach the eggs and fry. Furthermore, the fry must work their way up through the gravel, and they find this very difficult when sediment is present.

Considerable research has been done in artificial streams where conditions can be carefully controlled. Results indicate that round gravel collects more sediment than angular gravel at low streamflow rates. At streamflows much over 1 foot per second, however, the round gravel appears to be preferable. This information will be helpful to those who are considering construction of artificial spawning areas.

The amounts of streamside disturbance that are acceptable have been studied carefully, and results of this work are being applied in National Forests in the Northwest and Alaska.

Classifying Forest Habitats

The Intermountain Station has devised an improved system for classifying forest habitats in Montana. Useful classification systems with standard treatments for members of each class provide a means for identifying the various forest habitats. Scientists at the Intermountain Station believe that one problem in forestry in the northern Rocky Mountains has been inadequate classification of forest conditions. They found that wildlife biologists had one classification system, forest managers another, and other resource specialists still others. As a result, people in different disciplines had trouble communicating with each other.

The solution was to devise a system based on the ecological principles of plant succession. The idea of succession is that on land with given characteristics vegetation will pass through predictable stages to a predictable climax in the absence of disturbance. In their Montana classification, the scientists recognized 64 habitat types and 37 additional phases of the habitat types. Understory as well as overstory plants are considered in the system. Distribution, vegetation, and soils are described for each type and a key is provided to determine what type is present on a particular tract. Some notes on management are also provided.

Forested Scree

Abies lasiocarpa/Menziesia ferruginea

Abies lasiocarpa/Vaccinium scoparium

Abies grandis/Clintonia uniflora

Picea/Clintonia uniflora

Tsuga heterophylla/Clintonia uniflora

Thuja plicata/Clintonia uniflora

Abies lasiocarpa/Xerophyllum tenax

Pinus flexilis/Agropyron spicatum

Pinus ponderosa/Prunus virginiana

Pinus albicaulis-Abies lasiocarpa

Pseudotsuga menziesii/Vaccinium caespitosum

All About Western Larch

Research discoveries about a tree species normally come one at a time, rather than in bunches. As a result, researchers usually write articles about single discoveries. Foresters, however, need single publications that contain all the latest information about managing a species. Such publications save them a lot of time and effort. The Intermountain Station has produced information that a forester needs to manage western larch. A 96-page publication contains recommendations, tables, and charts. Economic, biological, and environmental considerations are detailed. Methods for managing and reproducing the species are provided, along with estimates of growth and yield under various conditions. A bibliography is provided for research scientists and others who require details that were not included.

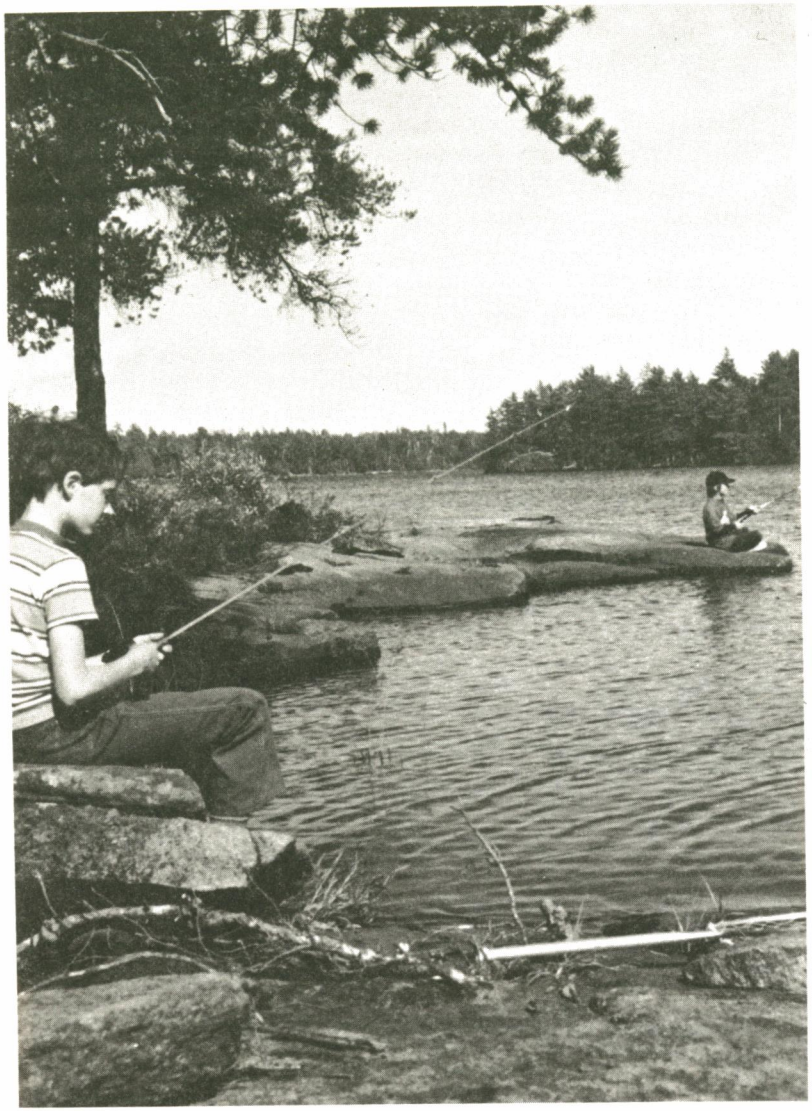
Economic Options for Southeast Alaskan Timber

A large supply of timber is one of the major assets of southeastern Alaska, and Forest Service management policy has been oriented to strengthen employment and economic growth in the area through its use. Recently, however, the sufficiency of this objective has been questioned.

Alaskans are becoming increasingly concerned about preservation of esthetic values both for themselves and for a growing tourist industry. The economic climate is also changing. The world market for dissolving pulp has weakened. One pulping firm plans to shift to a different product and another long-studied pulpmill development has been scratched. A large sawmill that produced dimension lumber has closed. The great distance to markets in the lower 48 States and restrictions on exports to Japan are major problems in marketing Alaskan timber.

Together, these conditions raise many questions for land managers and regional developers. To provide answers to these questions, a joint study was conducted by economists of the Pacific Northwest Station working with National Forest and State officials. Their report, which is still being reviewed by State and National officials, clarifies probable effects of timber management and sales options on employment and regional development, and provides an improved basis for developing long-term management strategies for southeastern Alaska.

Forest industries are an important source of employment, but Alaskans are concerned about preserving esthetic values both for themselves and for a growing tourist industry.



Growing Up Without Forests

The urban child of today sees far less of forests and fields than did his counterpart one generation ago. Does this lack of experience with nature adversely affect a child? No one knows for sure. Effects on psychological development, self-concept, and preparation for responsible citizenship are very hard to isolate and measure, but a lot of people are thinking about these things.

The Northeastern Station held a symposium on the topic, gathering leading scientists who have done related research. Their thoughts are contained in 33 papers printed in the symposium proceedings. The papers summarize what is now known and indicate promising areas for research on this important problem.

Managing Rivers for Recreation

Rivers are among our Nation's most valuable natural resources, and public concern about the best uses of rivers has been growing. Partly to aid in planning of future research, the North Central Station held a symposium of experts on river recreation, safety, and management. The papers presented at the meetings have been printed in a single publication, which is the best available summary of current knowledge about river management. It should be useful to various groups concerned with river recreation—planners and managers, public agency administrators, researchers, students, businessmen, members of recreation and conservation organizations, and private citizens.

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